weather, a project was especially generated to develop high level expertise in modelling and experimental design to study oceanic circulation and Air-Sea interface processes. This is being implemented through the establishment of a Cell in the Centre for Atmospheric Sciences at Indian Institute of Science, Bangalore.

5. *Monitoring and modelling of Pollution in the sea*

Systematic monitoring of pollution regimes along the entire coast of India and Islands has been recently established, to keep a surveillance on the health of our coastal seas and to develop an understanding of the dynamics of the ecosystem on which our near-shore living resources depend.

6. *Sea level variations*

A programme for establishing a network of 9 state-of-the-art tide-gauge stations along our coast and Islands is now underway towards documenting sea level variations, if any, with a high precision.

7. *Island Centre for Ocean Development*

Steps have been initiated for establishing a Centre for Ocean Development at Port Blair with a view to improving the quality of life and of human endeavour amongst the Islanders, whilst preserving the integrity of the fragile eco-system of the Andaman & Nicobar Group of Islands and ensuring a pattern of development in harmony with the environment.

8. *Aquaculture: Action Plan for alleviating poverty*

A projectized Action Plan on aquaculture aimed at developing special assets of the coastal wetlands is being implemented towards improving the quality of life in rural areas. This programme is monitored by a Special Steering Committee.

9. *An Integrated Wave energy generator—breakwater system to produce 2 MW of power*

Utilizing the experience gained KW wave generating unit to be installed shortly at Vizhinjam (Trivandrum), a 260 m long 20 Caisson wave generating system which will produce 2 MW of peak power has been designed to be incorporated in the breakwater at Thangassery, Kerala.

(b) Whilst most of these programmes have a long gestation period and are at various stages of R&D, short and long term viability of some of these programmes have been worked out. The cost of the integrated wave generator-breakwater system is approximately Rs. 20,000 per KW at an operational cost of Rs. 0.97 per unit of power. A pre feasibility study of the exploitation programme of polymetallic nodule shows that the internal rate of return on investment will be of the order of 15 per cent at the commercial stage of operation.

(c) The budget estimate of the Department of Ocean Development for the year 1990-91 is of the order of Rs. 35 crores which includes an anticipated foreign exchange component of Rs. 20 crores.

Expenditure on Space Research

2333. SHRI VITHALRAO MADHAVRAO JADHAV:

SHRI H. HANUMANTHAPPA:

SHRI PRABHAKAR B. KORE:

Will the PRIME MINISTER be pleased to state:

(a) what is the total expenditure incurred on space research;

(b) what have been the outstanding achievement of our space research so far;

(c) by when India would be able to launch satellites by its own space launching vehicles; and

(c) by when India would be fully self-sufficient in Space Research?

THE MINISTER OF STATE IN THE MINISTRY OF SCIENCE AND TECHNOLOGY (PROF. M. G. K. MENON): (a) Total expenditure incurred by Space Research from 1962 till March 31, 1990 is Rs. 2656.75 Crores.

(b) to (d) 1. Since its inception in 1962, Space Research in India has made substantial progress and contributions have made in : application of Space Technology for national developmental efforts; development of satellites; development of launch vehicles; and space sciences. An integrated Space Programme with carefully planned linkages between the national application needs, satellites and launch vehicles has emerged. Satellite-based national system have been made operational, through the INSAT and IRS satellite and related ground system, for communication, broadcasting, meterology, education, management of natural resources, drought management and disaster management, Nationl Natural Resources Management System (NNRMS) has been established in the country combining optimally the data received from Remote Sensing Satellites and conventional methods. Operational application of remote sensing technology has been established for the management of water resources, land resources, forestry environment and mineral resources.

2. The successful completion of the Satellite Instructional Television Experiment (SITE) and Satellite Telecommunication Experiment Project (STEP) demonstrated the feasibility of using satellites for broadcasting| communications. The first Indian Satellite Aryabhata was launched in 1975, followed by the Bhaskara-I & II satellites and the three axis stabilised APPLE satellite. These satellites provided opportunity for space-based remote sensing and communication experiments.

3. The Indian Remote Satellite (IRS-1A), designed and developed indigenously was launched in March, 1988. While the launch of IRS-IA was from USSR, the complete mission operation and control and payload operations are carried out by Department of Space. IRS-IA, which is a sate-of-the-art satellite, comparable with the contemporary foreign remote sensing satellites, is providing operational services for more than two years. The data from IRS-1A is a vital component of NNRMS. The second generation improved versions of IRC series of satellites are currently under development and expected to be launched in 1993-95 time-frame.

4. The first generation INSAT satellite *viz.* INSAT-1 Series were built by a foregn manufacturer as per the configuration and specifications laid down by the Department of Space . The Second generation larger INSAT satellites are being developed indigenously, with targetted launch of the first satellite by 1991-92.

5. The development of Sounding Rockets for conducting space science experiments was one of the early achievements in rocketry in the country. The capability for launching 50 kg class satellite was accomplished with the successful launchings of Satellite Launch Vehicle (SLV-3) carrying the Rohini Satellite.

6. Indigenous capability for launching 150 kg. class satellites in low earth orbit, has been planned to be achieved with the development of Augmented Satellite Launch Vehicle (ASLV). Next developmental flight of ASLV is scheduled for 1991-92. Capability for launching 1000 kg class Remote Sensing Satellite will be achieved with the development of Polar Satellite Launch Vehicle (PSLV). Substantial progress has been achieved in the development of

PSLV. The 125 tonne solid propellant booster, the third largest booster of its kind in the world, was tested successfully. A 37.5 tonne liquid rocket engine having the heritage of Ariane Launch Vehicle has been indigenously realised and successfully tested. The first developmental flight of PSLV is scheduled for 1991-92.

7. In order to achieve self-reliance in the launching of INSAT Class satellites, development of Geosynchronous Launch Vehicle (GSLV)) and a Cryogenic Engine & Stage has been envisaged. With the succesful accomplishment of the Polar Satellite Launch Vehicle (PSLV) Project, capability to launch Indian Remote Sensing Satellites (IRS) can be achieved and the development of Geostationary Satellite Launch Vehicle (GSLV) will help to achieve capability to launch IRS/INSAT satellites, around the mid-nineties.

8. The sounding rocket launch station at Thumba and Balasore are being used for conducting space science experiments. The national rocket launching station at Sriharikota has been developed for launching of SLV-3|ASLV|PSLV already.

9. Expertise and facilities have been established in the country for tracking, commanding and controlling Geosynchronous satellites, Polar Synsynchronous satellite and Low-earth orbiting satellites.

10. The Indian industry, in the public and private sectors, has been involved as a major partner in the Indian Space Programme. Indigenous capability has been established in critical high technology areas like Maraging Steel, Propellant materials, Inertial Systems, Space-craft Mechanisms, Optical Sensors etc. A number of technologies developed by the Department of Space have been successfully transferred to industry for commercial exploitation.

11. It has been possible to build up and sustain a competent, dedicated and trained manpower in this high technology area. Innovative management system have been evolved for the management of complex space projects.

12. Space research is a continuous process of Research & Development. Self reliance and a high degree of self-sufficiency in the various application areas can be achieved with the successful accomplishment of the projects and programmes mentioned above.

Import of High Technology in the Field of Science and Technology

2334. SHRI VITHALRAO MADHAVRAO JADHAV:

SHRI H. HANUMANTHAPPA:

SHRI PRABHAKAR B. KORE:

Will the PRIME MINISTER be pleased to state:

(a) what are Government's plans for the import of high technology in the field of Science and Technology;

(b) what has been the percentage of contribution of Science and Technology Department especially by CSIR, to provided indigenous high technology to our sophisticated and modern industries; and

(c) what amount of foreign exchange is spent per year for importing new technology?

THE MINISTER OF STATE IN THE MINISTRY OF SCIENCE AND TECHNOLOGY (PROF. M. G K. MENON): (a) As per the Technology Policy of the Government, in the acquisition of know-how from abroad, the import of technology is permitted on a selective basis where need has been established: technology does not exist within the country; and the time taken to generate technology indigenously would delay the achievement of development targets. Technology acquisition from outside shall not be at the expense of national interest. In the acquisition of technical know-how, consideration is given to the choice and source of technology, alternative means of